

Bioremediation of a High-Concentration Chlorinated Solvents Mixture

Bioremediation with ISCO Polishing

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**CDM
Smith**

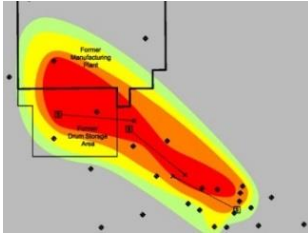
Battelle's Fourth International Symposium on
Bioremediation and Sustainable Environmental Technologies

Miami, Florida
May 22-25, 2017

Overview



Site Description/Full Scale Design



Enhanced Anaerobic Bioremediation (EAB) with Groundwater Recirculation



ISCO, Excavation, ZVI

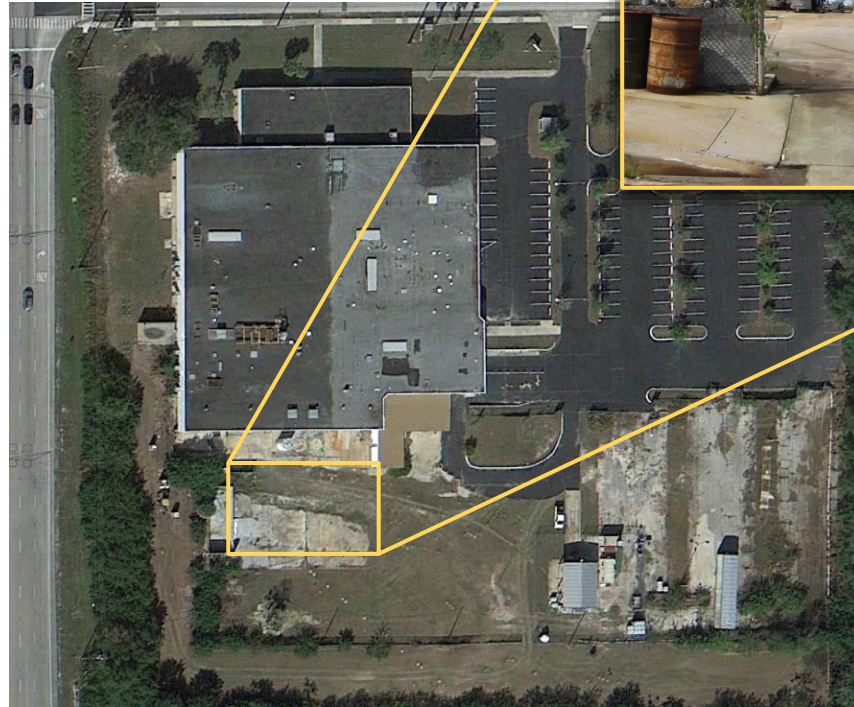
Former Industrial Manufacturing Facility with TVOC >100,000 – 2,300,000 $\mu\text{g}/\text{L}$

Primary Contaminants:

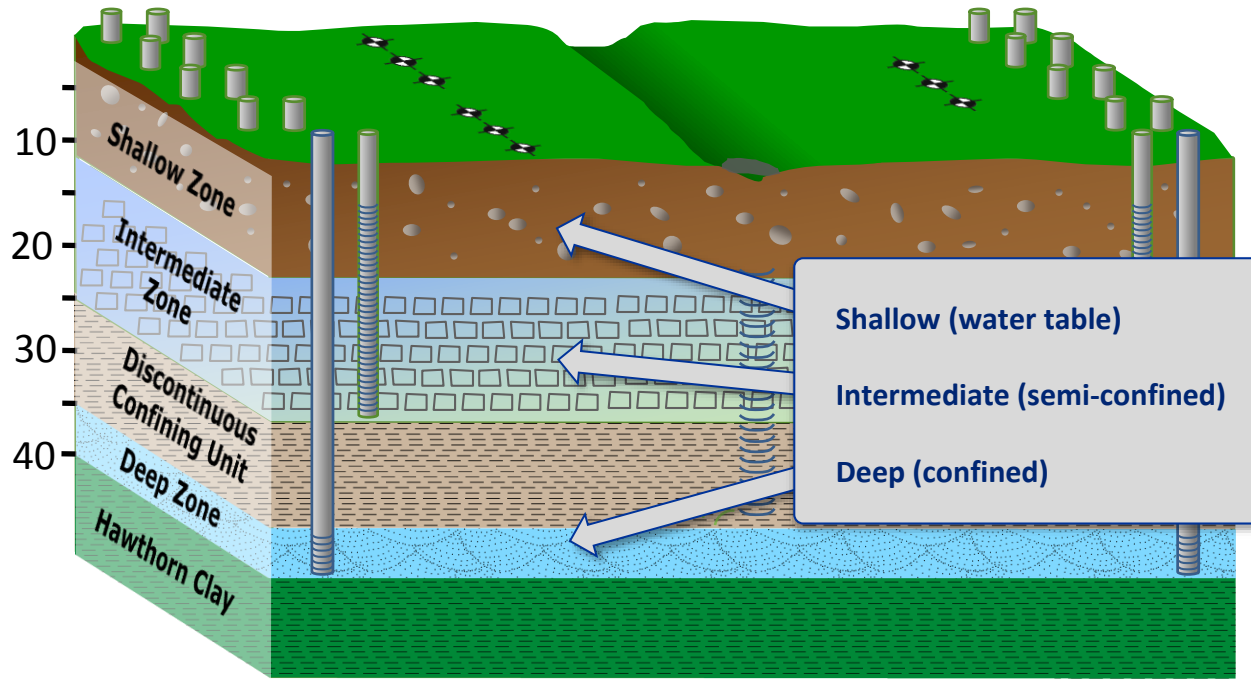
- 1,1-DCE
- 1,1,1-TCA
- Methylene chloride

Secondary Contaminants:

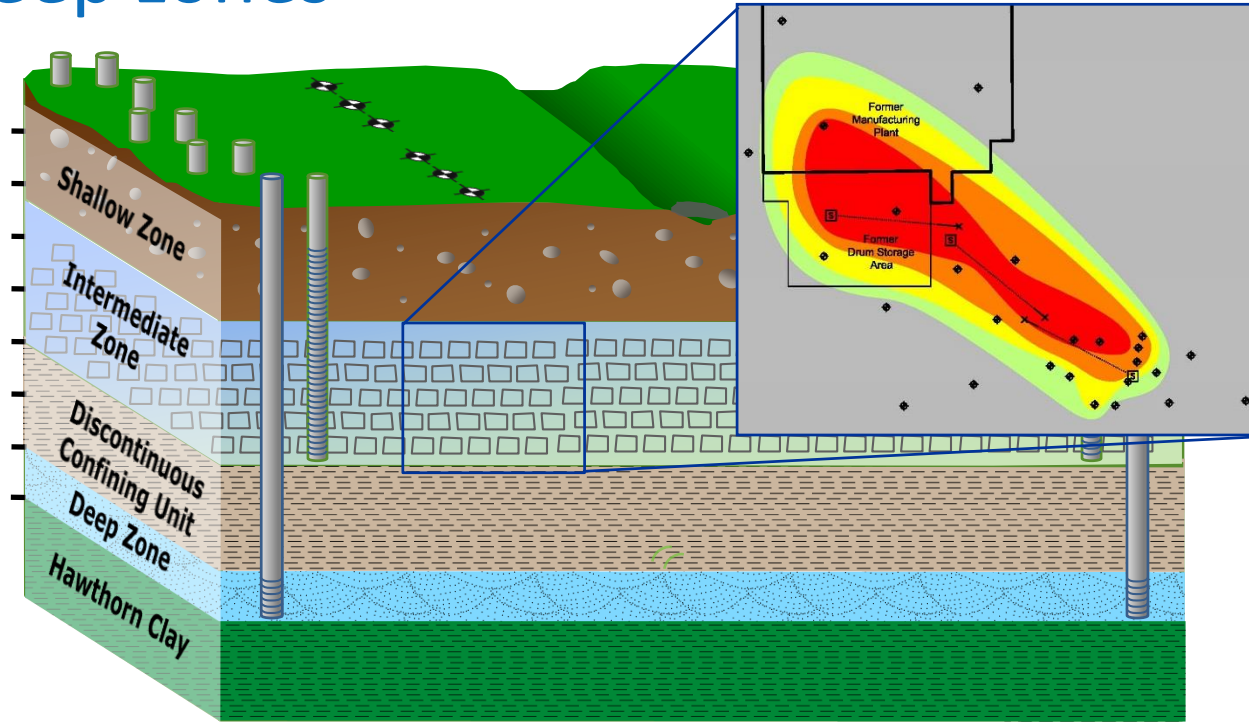
- PCE
- TCE
- cis-1,2-DCE
- Vinyl chloride
- 1,1-DCA



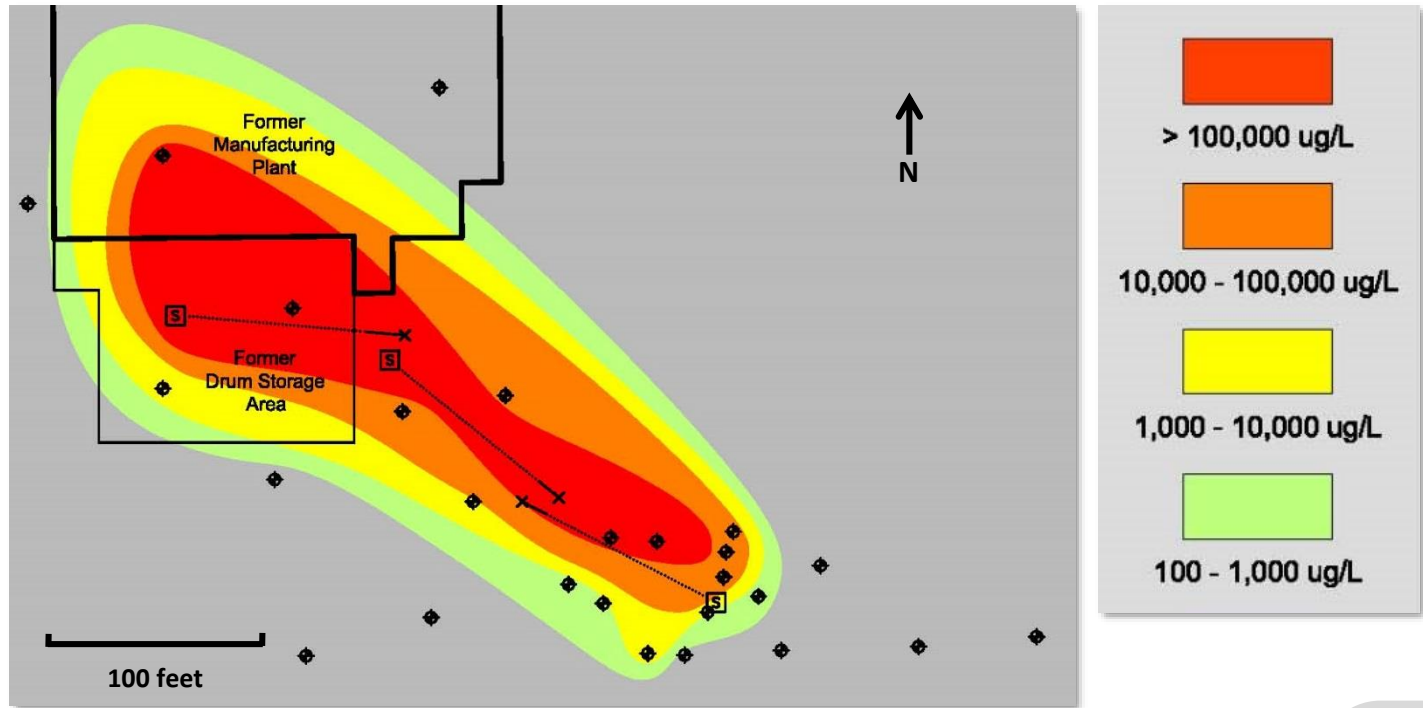
The surficial aquifer has three zones;
the intermediate & deep zones had the highest VOC concentrations



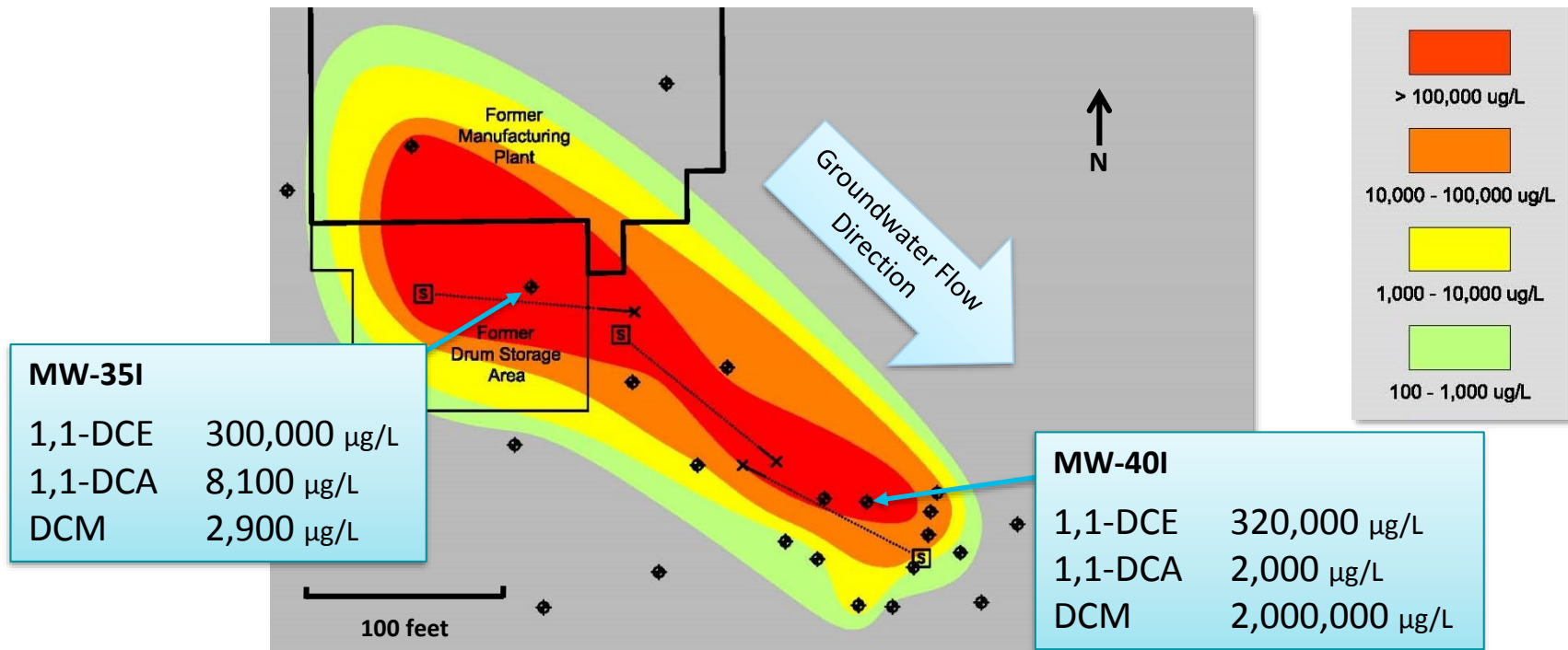
Results were similar for shallow, intermediate, and deep zones



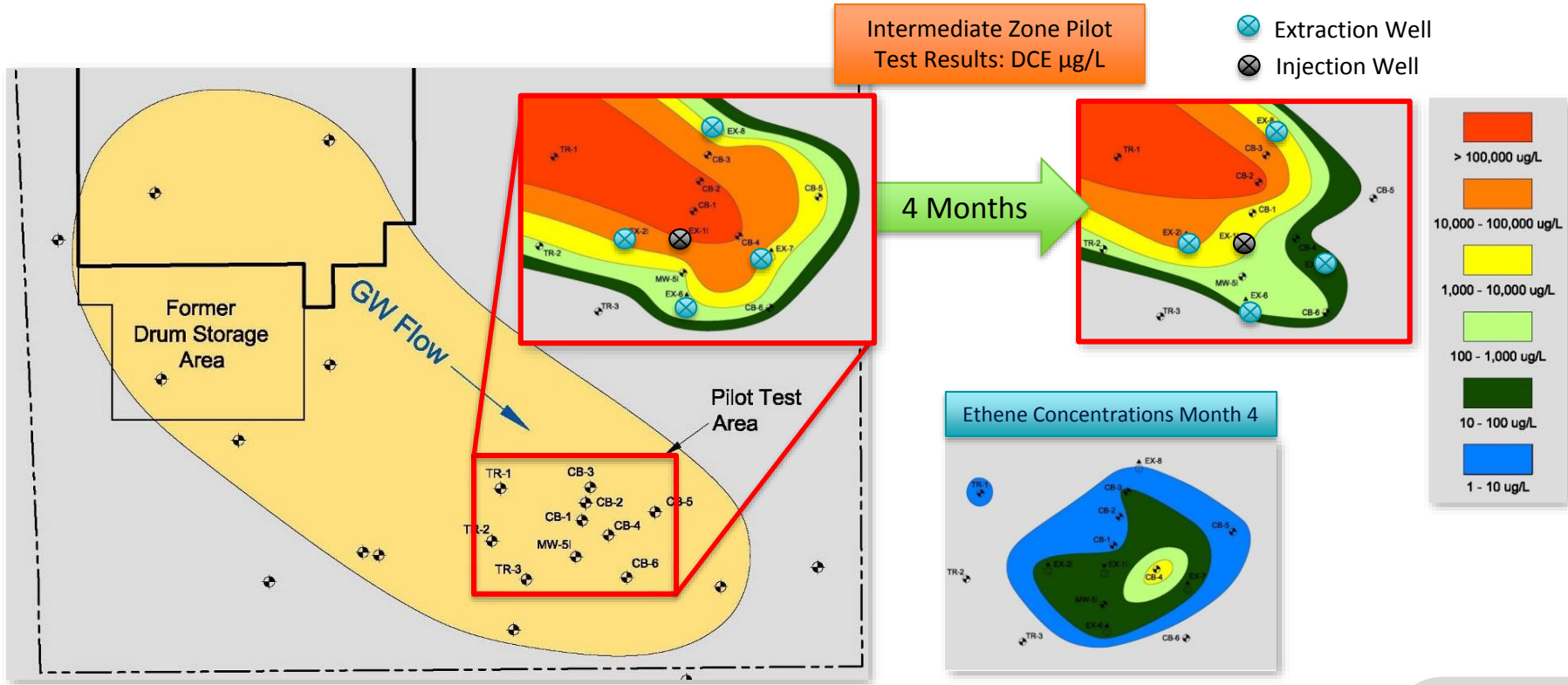
Baseline TVOC results showed multiple wells above 100,000 $\mu\text{g/L}$



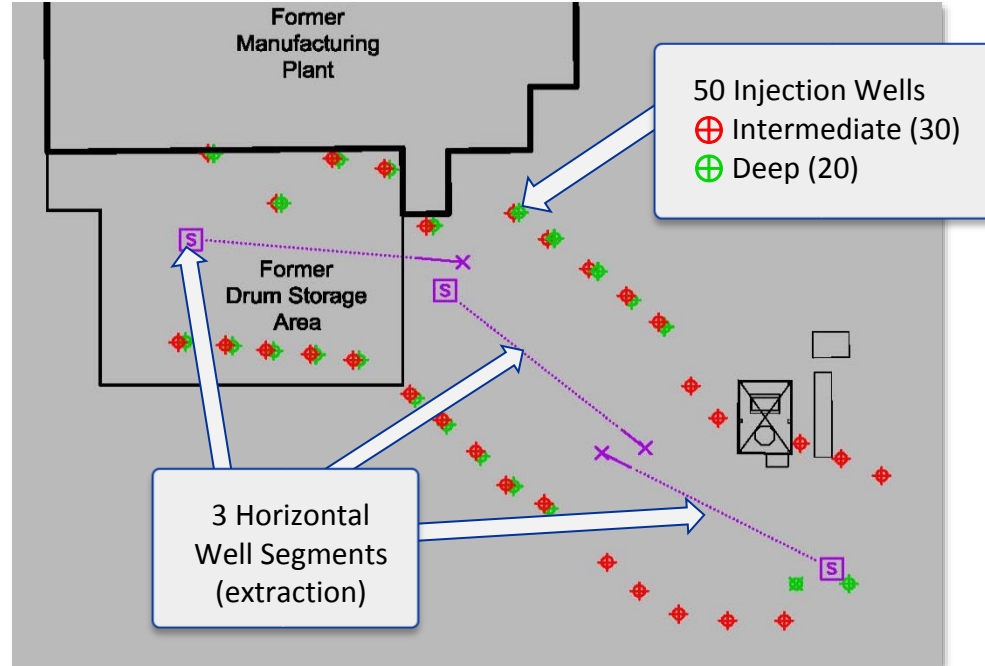
The plume was a high concentration mix of several contaminants with one well having TVOC concentrations over 2 million $\mu\text{g/L}$



Potassium lactate injection combined with groundwater circulation showed best results compared to other onsite pilot studies

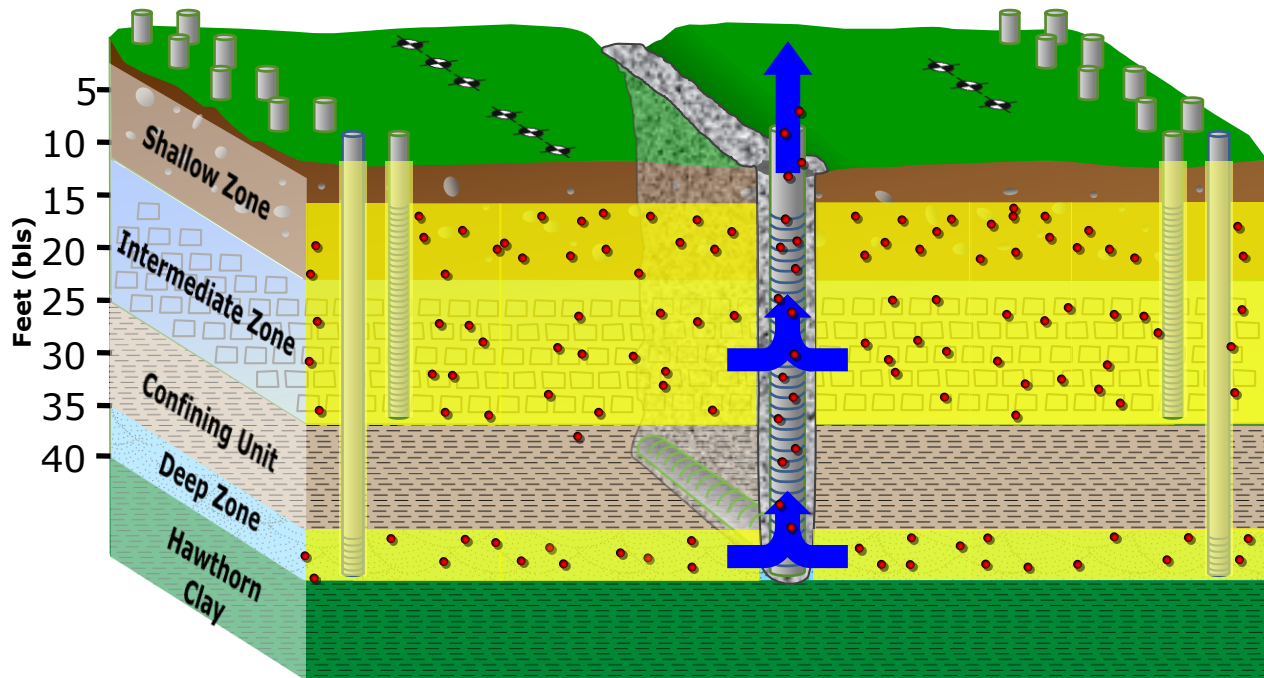


Full-scale EAB: horizontal wells (extraction) and injection wells used to distribute lactate



Horizontal Wells cut through all 3 surficial aquifer zones





LEGEND



- Water Extraction



- Potassium Lactate

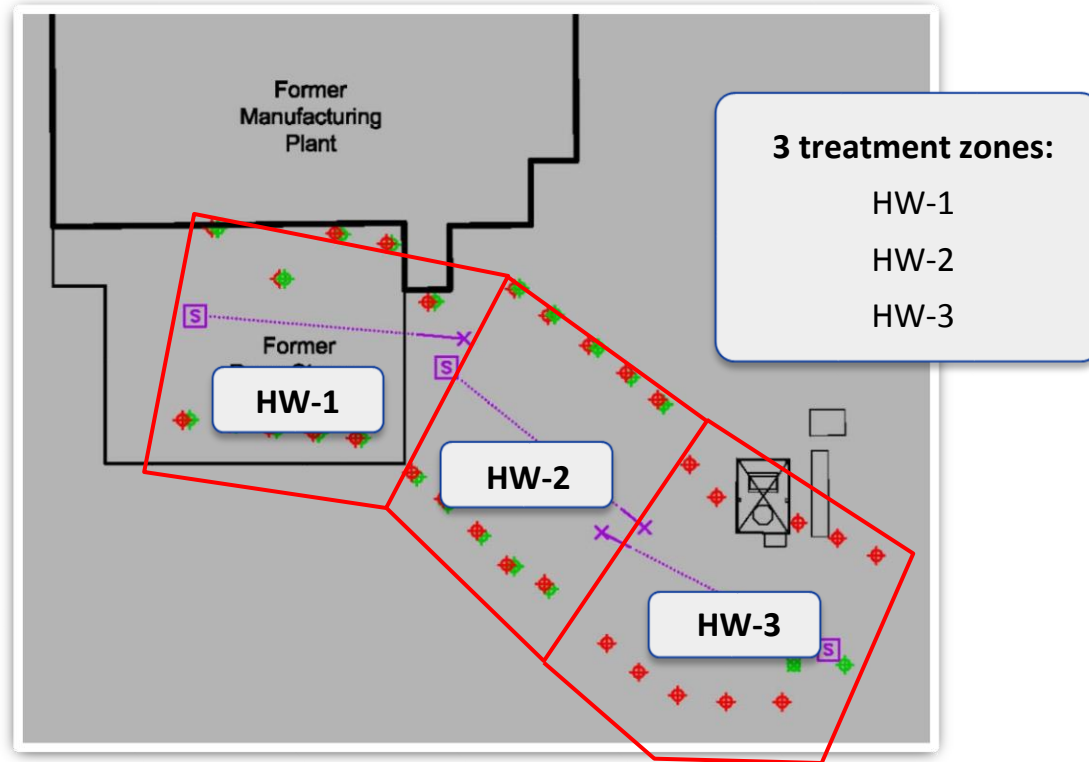


- *Dehalococcoides* spp.

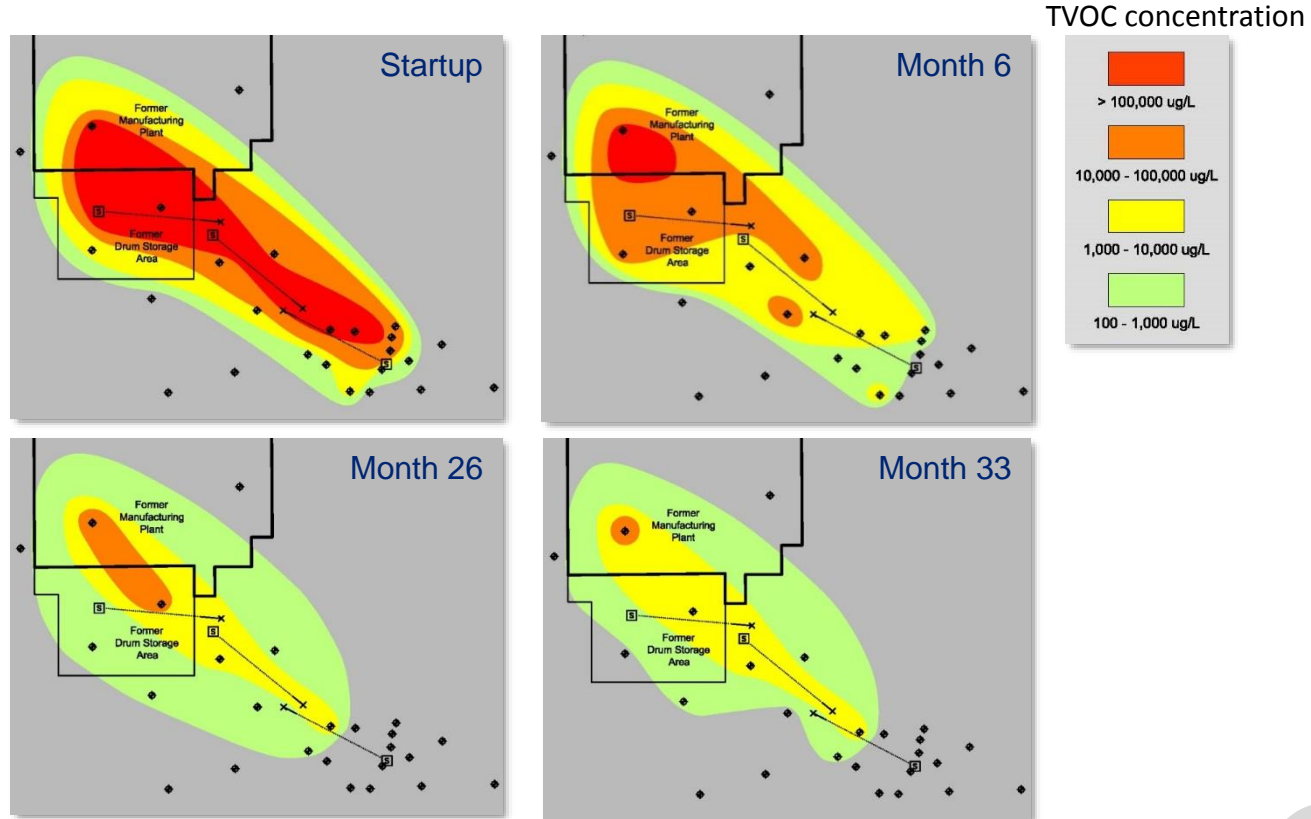


- Monitor Wells

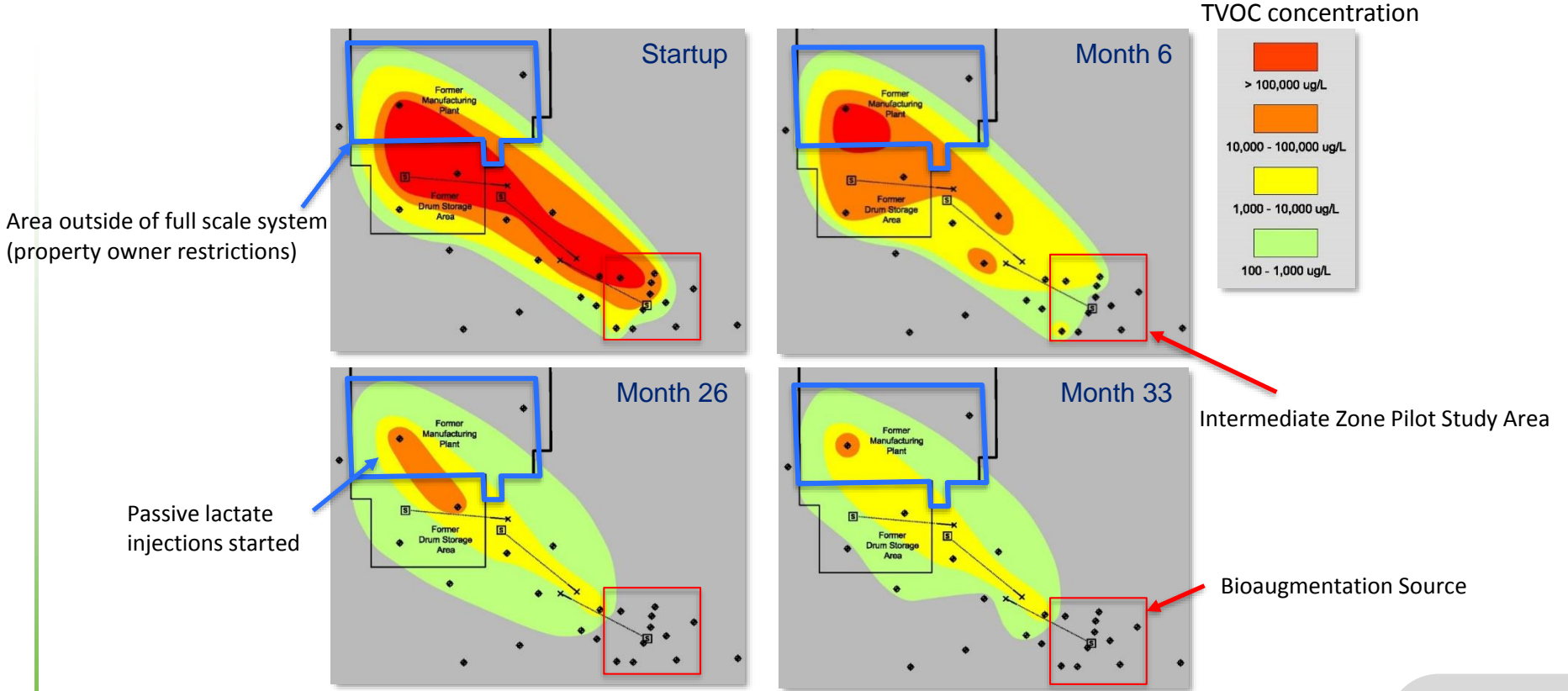
Lactate is pulsed into each horizontal well (HW) treatment zone while groundwater is recirculated in each closed zone



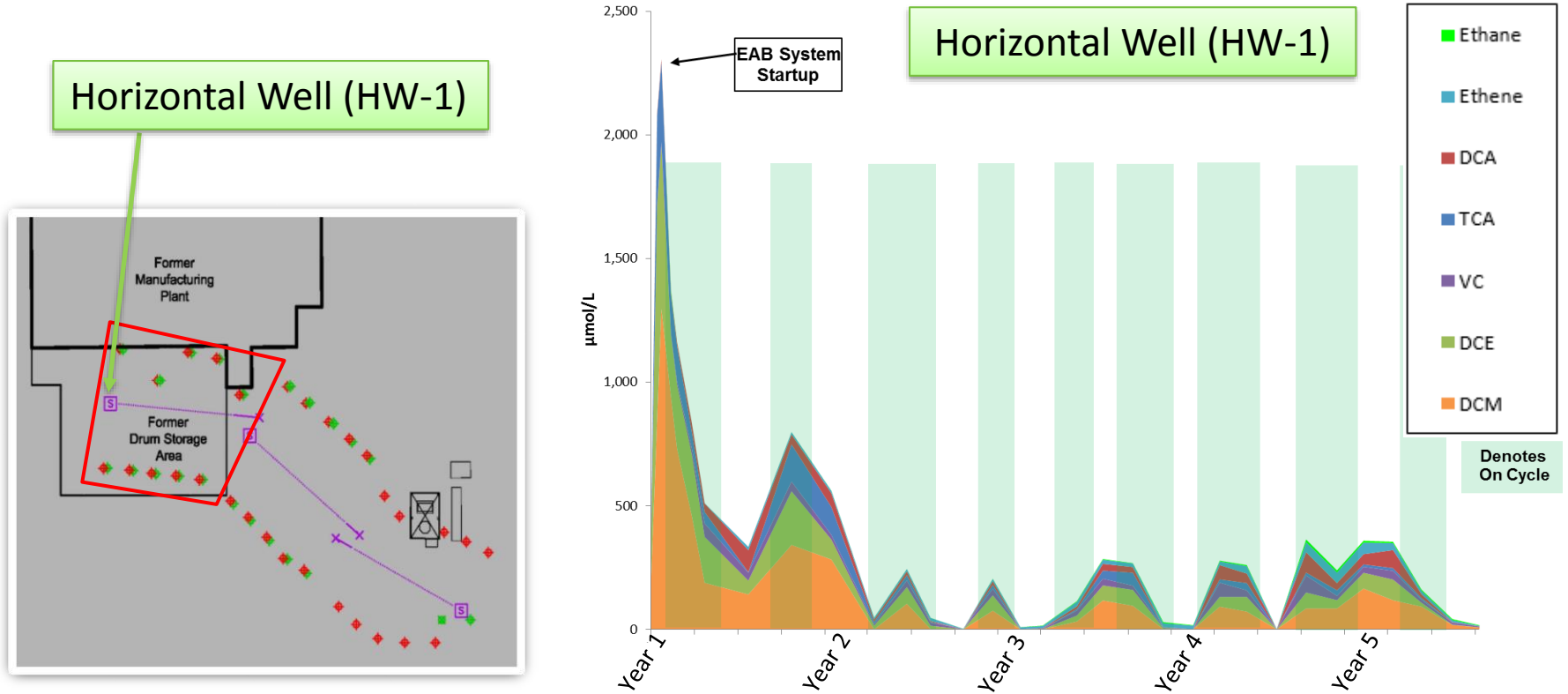
Within the first 33 months after startup, estimated VOC mass went from 2,800 lbs to 30 lbs



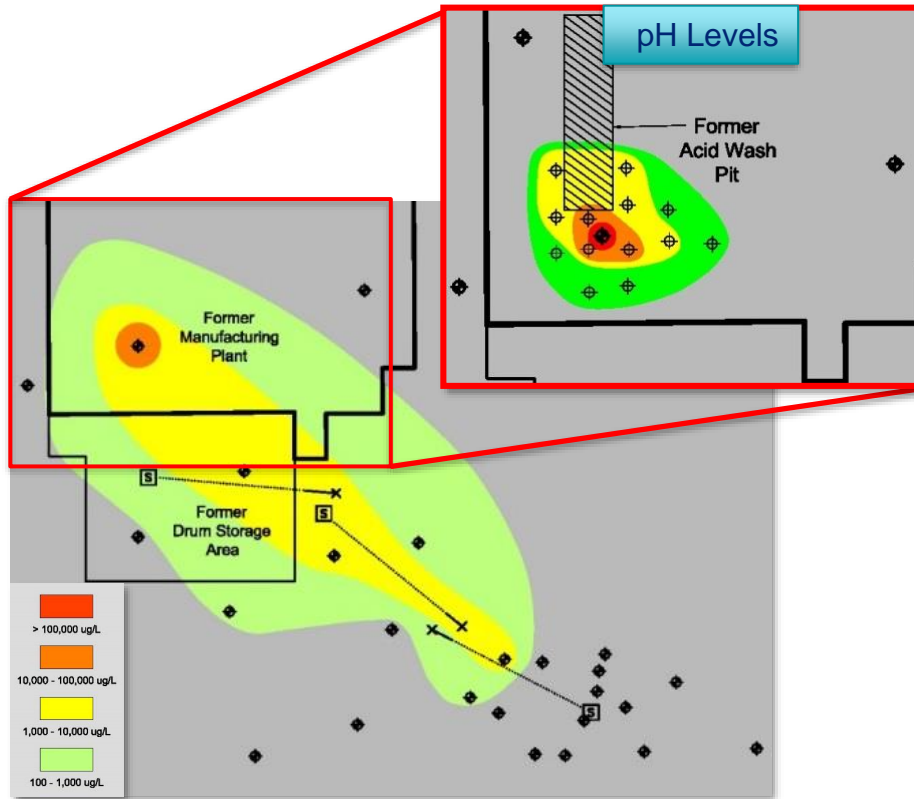
Horizontal well treatment zone that contained the pilot study reached lowest concentrations the fastest



Molar concentrations of VOCs from Horizontal Well 1 indicate complete breakdown of parent products



Low pH resulted in slower degradation under the building, so a small area was excavated and treated with ZVI



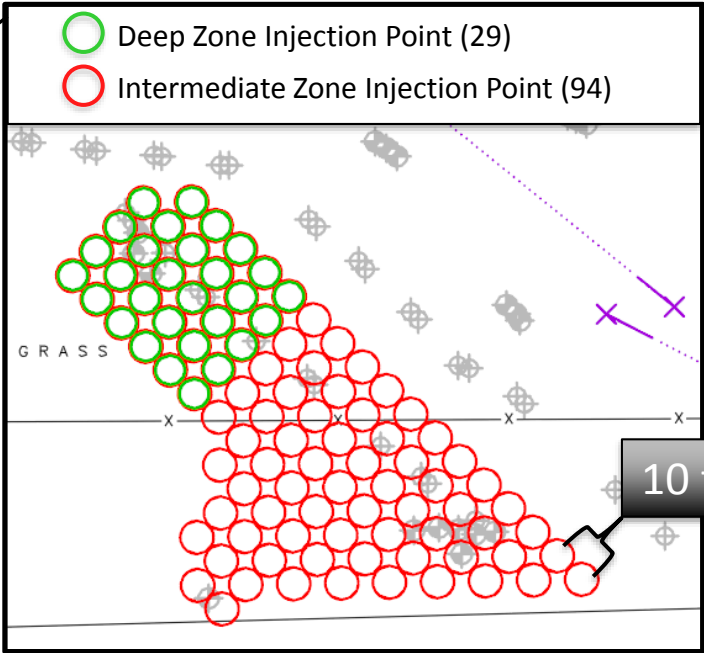
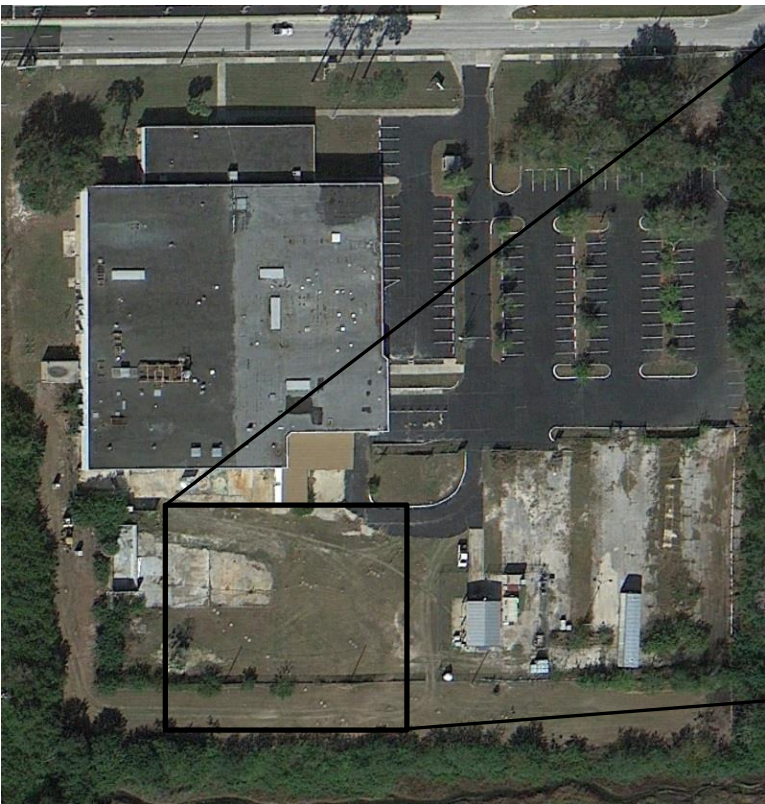
pH (SU)



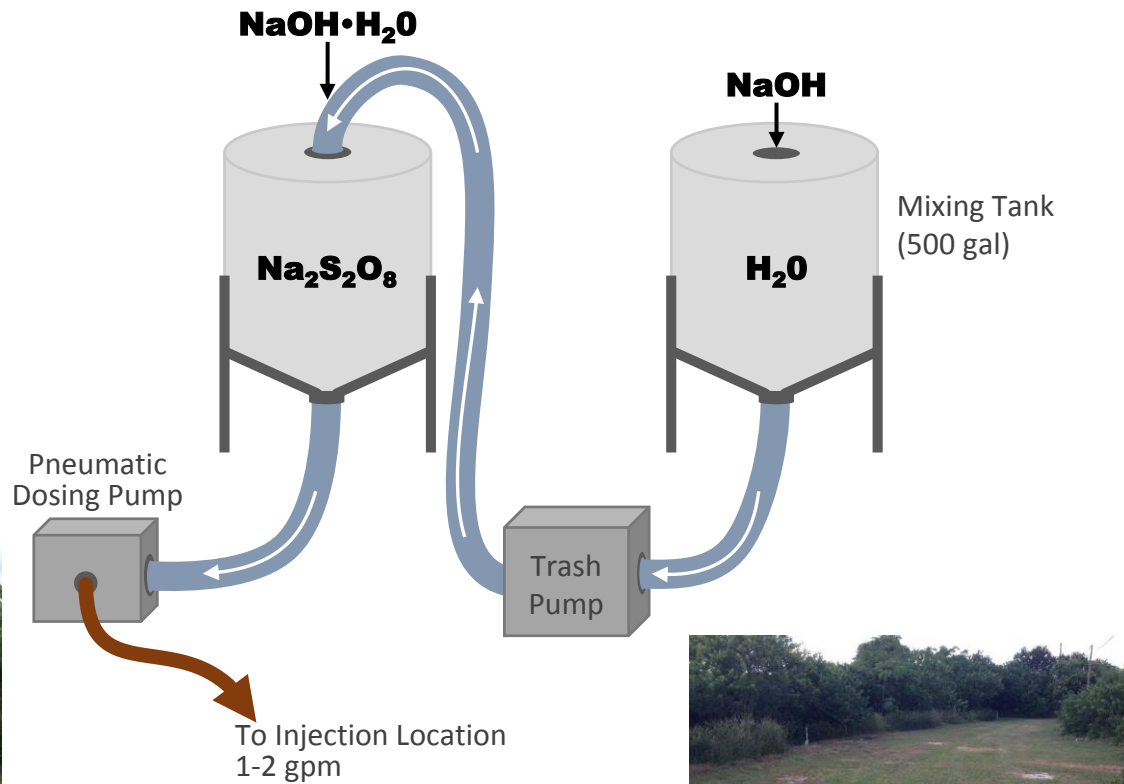
The goal of ISCO was to treat low level concentrations both inside and outside of the full-scale treatment zone



Baseline Sampling, Soil Oxidant Demand Testing, and Injection Testing were conducted to determine dosing concentrations, volumes, and injection rates



Target Dosing:
3 g persulfate/kg soil

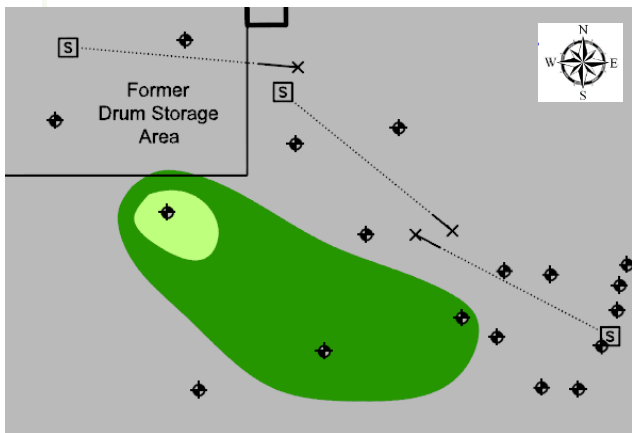


Target Dosing: 75 gals/location
19.7% sodium persulfate
25% sodium hydroxide

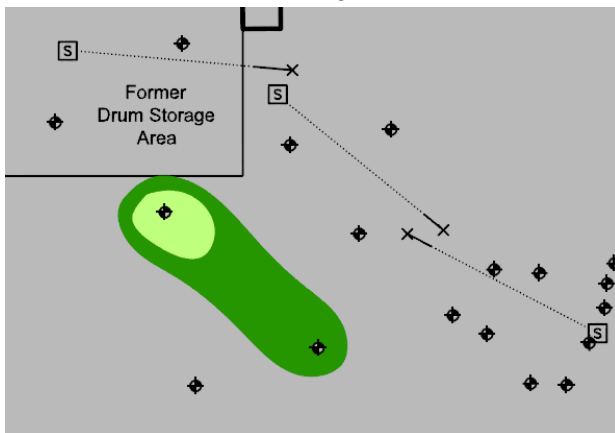


The ISCO injections decreased the size of the remnant plume, effectively pulling it away from the southern property boundary

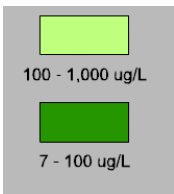
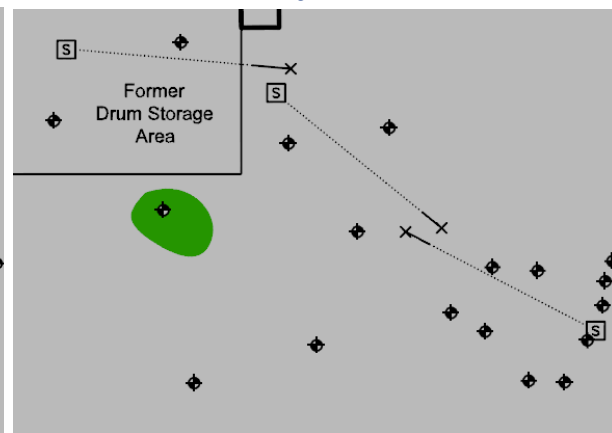
Baseline TVOC



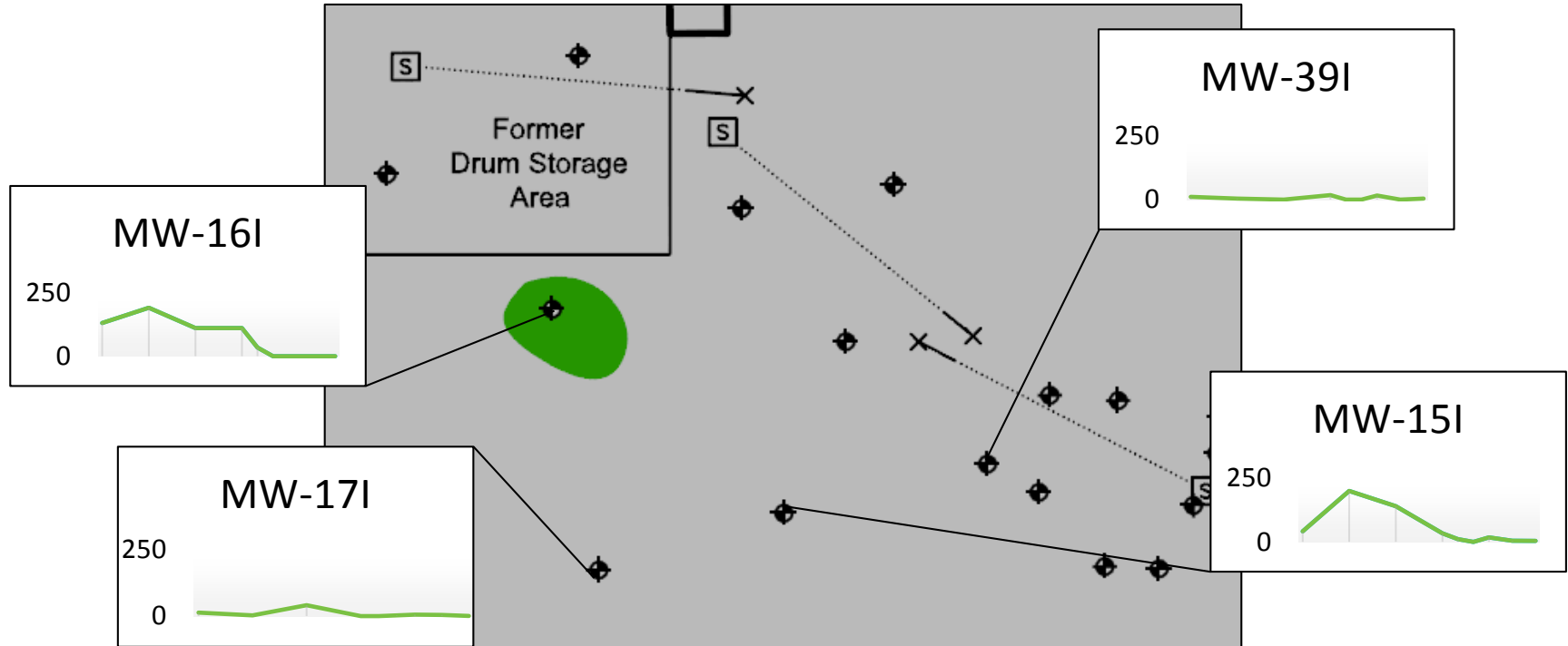
1 Month Post Injection TVOC



1 Year Post Injection TVOC



TVOC concentrations remained low one year after ISCO treatment



Currently, the site is in the process of obtaining Site Closure with FDEP under Chapter 62-780 FAC

Deed

GENERAL WARRANTY DEED

THIS GENERAL WARRANTY DEED, is made and entered into as of the



DECLARATION OF RESTRICTIVE COVENANT

THIS DECLARATION OF RESTRICTIVE COVENANT (hereinafter "Declaration") is made by a Florida limited liability company (hereinafter "GRANTOR") and the Florida Department of Environmental Protection (hereinafter "FDEP").

RECITALS



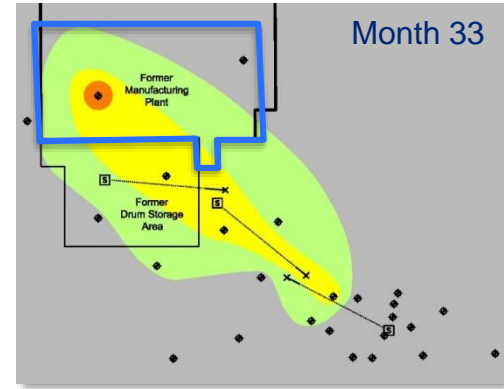
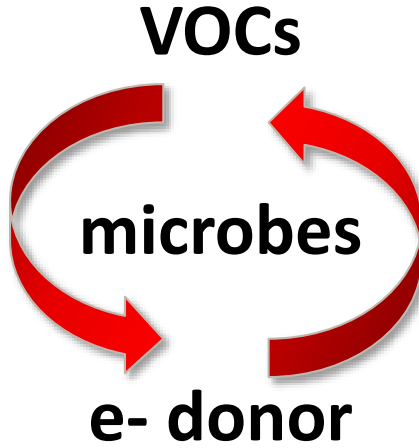
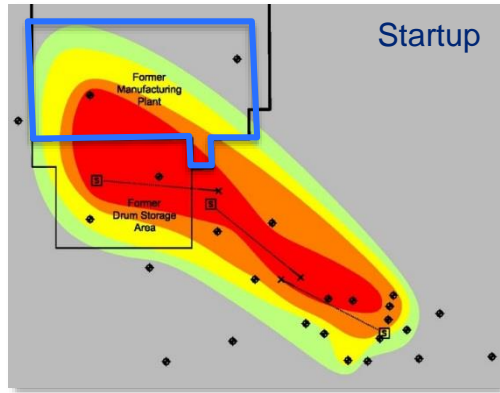
No Further Actions
with Controls

Engineering Control
Maintenance Plan

Site Survey



In summary, groundwater circulation was key to fast results.



ISCO, excavation, and ZVI were used for remnant contamination.





Questions?